CONSOLIDATION OF CLAY FROM SUKODONO BY ADDING STABILIZATION MATERIAL WITH WOOD CHARCOAL POWDER

To fulfill part of the requirements
to reach a Bachelor Degree of Civil Engineering

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APPROVAL SHEET

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Thus this statement I made with the truth and hopefully can be used properly.

Surakarta, July 24 ,2017

Writter,

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ABSTRACTION
CONSOLIDATION OF CLAY FROM SUKODONO BY ADDING STABILITATION MATERIAL WITH WOOD CHARCOAL POWDER

(A Case Study on Sukodono, Sragen)

Soil sukodono is clay with LL: 85,73%,PL: 24,69%,PI: 61,04% (Prasetyo 2016). The main problem on soil is the soil condition is less stable (expansive soil) so this soil is necessary for soil improvement. Soil improvement is carried out by chemical soil stabilization usin wood charcoal powder with percentage 10%, 15%,and 20%. The result of the physical properties of the native soil and the mixture obtained plastic limit value has increase, while the water content, specific gravity , liquid limit, plasticity index, shinkage limit, and sieve 200 percent decline. The soil mixture classification of 10% and 15% charcoal powder included the A-7-6, 20% group A-7-5. Soil mixture of wood charcoal powder 10%,15%,and 20% according to USCS system including CH group. The result of test mechanical properties from standart proctor test with mixture wood charcoal powder10%,15%,and 20% decrease value of volume weight and increase of optimum water content. The maximum weight value of the volume is 1,182 gr/cm^3 and the highest optimum water content is 38% in the addition of percentage 20% wood charcoal powder.In the consolidation test the value of the consolidation coefficient (Cv) increased as the addition of stabilization materials. At compression index value (Cc) as addition of stabilization material the value of Cc decreases. And for the value of settlementconsolidation (Sc) decreased with addition of stabilization materials. Of the soil stabilization variation in the percentage of added wood charcoal powdered, obtained the percentage of a change in value Cv , Cc , and Sc against native soil.Thus the addition stabilization of wood charcoal powder on soil in sukodono district of sragen regency has improved the mechanical characteristic.

Keyword : ***coefficients consolidation , consolidation , comprasion index , clay, settlement consolidation , wood charcoal powder***

ABSTRAK

Sukodono tanah liat dengan LL: 85,73%, PL: 24,69%, PI: 61,04% (Prasetyo 2016). Permasalahan utama pada tanah adalah kondisi tanah yang kurang stabil (tanah ekspansif) sehingga tanah ini diperlukan untuk perbaikan tanah. Perbaikan tanah dilakukan dengan stabilisasi tanah kimiawi pada serbuk arang kayu dengan persentase 10%, 15%, dan 20%.Hasil sifat fisik tanah asli dan campuran yang diperoleh nilai batas plastiknya meningkat, sedangkan kadar air, berat jenis, batas cair, indeks plastisitas, batas shinkage, dan saringan turun 200 persen.Klasifikasi campuran tanah serbuk arang kayu 10% dan 15% termasuk kelompok A-7-6, 20%

A-7-5. Campuran tanah bubuk arang kayu 10%, 15%, dan 20% sesuai dengan sistem USCS termasuk kelompok CH. Hasil uji sifat mekanik dari uji proctor standart dengan campuran tepung arang kayu10%, 15%, dan 20% penurunan nilai volume berat dan kenaikan kadar air optimum. Nilai bobot maksimum volume adalah 1.182 gr / cm3 dan kadar air optimum tertinggi adalah 38% pada penambahan persentase 20% serbuk kayu arang. Pada uji konsolidasi nilai koefisien konsolidasi (Cv) meningkat sebagai penambahan Bahan stabilisasi. Pada nilai indeks kompresi (Cc) sebagai penambahan bahan stabilisasi nilai Cc menurun. Dan untuk nilai settlementconsolidation (Sc) menurun dengan penambahan bahan stabilisasi. Dari variasi stabilisasi tanah pada persentase serbuk arang kayu tambahan, diperoleh persentase perubahan nilai Cv, Cc, dan Sc terhadap tanah asli. Dengan demikian penambahan stabilisasi bubuk arang kayu pada tanah di kabupaten sukodono kabupaten sragen telah membaik Karakteristik mekanisnya.

Kata kunci: konsolidasi koefisien, konsolidasi, indeks kompas, tanah liat, konsolidasi permukiman, serbuk arang kayu

1. INTRODUCTION

1.1 Background

In the previous research conducted by Prasetyo (2016), shows the soil in Sukodono a high plasticity clay, with a value LL = 85.73%, PL = 24.69%, PI = 61.04% (Appendix 1). In the test chemical elements that do Analytical Chemistry Laboratory MIPA UGM, Sukodono soil contains soil chemical element = 16.86% Al2O3, CaO = 0.92% = 10.81% Fe2O3, MgO = 1.35%, and SiO ¬2 = 63.25% (appendix 2). Based on the value of PI = 61.04% (over 17%) and the soil requiring corrective action. In order to overcome the problems existing soil conditions in the area Sukodono, it is necessary to study soil improvement that is by stabilizing the soil.

Soil stabilization have done a lot to improve the quality of the clay. In this study, using material added wood charcoal powder as an ingredient in stabilizing the soil in order to achieve conditions and soil properties better with sekunder data. Wood charcoal powder has the ability to improve the circulation of water and air, can sequester carbon, easily accessible, and economical price.

1.2 Problem Formulation

Based on this background, the problem can be formulated as follows:

1. How does the physical properties and mechanical native soil from the District Sukodono, Sragen?
2. How does the physical properties and mechanical ground of the District Sukodono, Sragen that has been stabilized using wood charcoal powder?
3. What is the magnitude of the values of coefficients consolidated (Cv), index compression (Cc) and settlement consolidation (Sc) soil from Sukodono, Sragen with an increase of wood charcoal powder.

1.3 Objectives and Benefits

Research Objectives

1) Knowing the physical properties and mechanical native soil from the District Sukodono, Sragen.

2) Knowing the physical properties and mechanical ground of the District Sukodono, Sragen that has been stabilized using wood charcoal powder.
3) Know the magnitude of coefficients consolidated (Cv), index compression (Cc) and settlement consolidation (Sc) soil from sukodono, sragen by the addition wood charcoal powder.

Benefit Research

1) Improving soil Sukodono subdistrict, Sragen stabilized using wood charcoal powder.
2) provide solutions and alternative material added to stabilization soil loam of powder wood charcoal by test consolidated , completing research preexisting .
3) As an input to the agency about the condition of the soil, so it can plan a safe construction.

1.4 Limiting Problem

In order to prevent the expansion of the discussion of this final project, this research needs to their scope as follows:

1. The study was conducted in the laboratory of Civil Engineering University of Muhammadiyah Surakarta.
2. Sample is clay with undisturbed conditions (disturbed) taken from the District Sukodono, Sragen with soil depth of approximately 50 cm.
3. Variations addition of charcoal as a stabilizing agent that is equal to 10%; 15%; and 20% of the weight of the sample with the conditions of optimum water content (w_{opt}) and maximum volume weight of dry soil (γ_d max).
4. The powder used for charcoal is wood charcoal powder from Surakarta to the size of the number 40 sieve
5. The use of secondary data for powdered charcoal and clay Sukodono
6. Testing taken include:
    a) Testing the physical properties of the soil in the form of specific gravity (Gs) (ASTM D8554-58), water content (w) (ASTM D2216-

71), the limits of Atterberg (ASTM D423-66), and grain size analysis (ASTM D421 -58).

b) Testing of soil density with Standard Proctor (ASTM D 698) on the native soil and soil mix.

c) Testing consolidated.

1.5 Authenticiy Research

Research the characteristics of clay from Sukodono, Sragen stabilized using chemical methods with materials of wood charcoal with the title "Tinjauan Kuat Dukung Tanah Lempung Sukodono Kabupaten Sragen Dengan Penambahan Prosentase Bahan Stabilisasi dari Bubuk Arang Kayu" has not previously been carried out research at the Faculty of Engineering Department of Civil Engineering, University of Muhammadiyah Surakarta.

Similar research had previously been done Sangeoris (2016) entitled "Pemanfaatan Bubuk Arang Kayu Sebagai Bahan Stabilisasi Terhadap Kuat Dukung Tanah Lempung Sukodono dengan Variasi Perawatan ", this study uses wood charcoal powder as a soil stabilization material with a percentage of 0%; 5%; and 7.5% and the testing performed is strong to support the soil (California Bearing Ratio).

Similar research had previously been done Karaseran (2015) with the title "Pengaruh Bahan Campuran Arang Tempurung Terhadap Konsolidasi Sekunder Pada Lempung Ekspansif", this study uses coconut shell charcoal as a soil stabilization material with a percentage of 0%; 4%; 6%; 8%; and 10% and the tests were conducted Consolidation test.

2. RESEARCH METHODS

2.1 General Review

In this study to determine soil characteristics to be studied need to do some testing. Tests performed include testing the water content, specific graphite (Gs),

the limits of Atterberg (liquid limit, plastic limit and shrinkage limit), standard proctor, and testing of consolidation.

2.2 Research Material

Materials made as test object as follows:

1. Soil samples derived from the District Sukodono, Sragen with disturbed conditions, soil acquisition is done at a depth of approximately 50 cm.
2. The water used comes from the Civil Engineering Laboratory of the University of Muhammadiyah Surakarta.
3. Charcoal powder wood used comes from the city of Surakarta with sieve size No. 40

2.3 Research equipment

The equipment used in this study are as follows:

1. A set of the specific gravity(gs)
2. A set of a test water levels
3. A set of a test hydrometer
4. A set of a test sieve analysis
5. A set of a test atterberg
6. A compacted standard
7. A consolidated test
8. A tools consisting of the oven, the balance with thoroughness 0,001, thermometer, picnometer, the stopwatch, a measuring glass 1000 ml, desicatori and the cup.

2.4 Stages Research

Research is composed of several stage, among others :

1. Stage I

   Belongs to an early stage starting with literature study and supply of soil samples material and wood charcoal powder.

2. Stage II

Testing caracteristic fisis native soil and soil mixed with the addition of wood charcoal as much as 10 %, 15 %, and 20 %.Testing these include water levels, the specific gravity, limits *atterberg*, And analysis of size granules .Then do the solidification with a standard a proctor in order to obtain the density of soil maximum and the water level optimum .The water level the steady used for the manufacture of sample testing consolidated.

3. Stage III

At this stage will be conducted testing consolidated, testing specific gravity, and testing the consistency of (limits atteberg soil loam soft sukodono with a mixture of powdered charcoal wood with prosentase variation mixture of 10 %, 15 % and 20 %

4. Stage IV

This stage is discussion of the tests have obtained from stage II and III. From this stage can be made the conclusion will the results obtained and give advice if needed.

3 Analysis and Discussion

3.1 Introduction Research

Based on research conducted by prasetyo (2016) .Test results of the chemical elements the soil (prasetyo , 2016). Test results of the chemical elements wood charcoal powder (sangerois , laboratory analytical chemistry of chemical the faculty MIPA UGM)

3.2 Physical Properties Test

1. Test the specific gravity

A. Wood Charcoal Specific Gravity Test

According to research conducted by Soemeinaboedhy and Tejowulan (2004).Result spesific grafity of the wood charcoal powder is 1,1.

B. Native Soil Test

Tabel V.3. Result of Native Soil Physical Test

Water Content (%)	Specific Gravity	Liquid Limit (%)	Plastis Limit (%)	Shrinkage Limit (%)	Index Plastisity (%)	Loose Sieve No.200 (%)	Soil Classification	
							AASHTO	USCS
18,323	2,621	91,50	27,04	11,30	64,46	91,00	A-7-5	CH

C. Test of Soil Mixture

a. Test the specific gravity

Table V.4 .Test the specific gravity of native soil and soil by prosentase an additional ingredient wood charcoal powder 10 % , 15 % , and 20 %

Test	Percentage Stabilitation	Sample		Average
		1	2	
Gs	Native soil	2,735		2,735
Gs	10%	2,474	2,462	2,468
Gs	15%	2,431	2,425	2,428
Gs	20%	2,381	2,382	2,409

b. Test atterberg limit

Addition Charcoal Wood Powder (%)	Specific gravity	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Shrinkage Limit (%)	Plastisity Indeks (%)	Loose Sieve No.200	Group Indeks (GI)	Classification	
									AASHTO	USCS
10	2,468	25,493	62,20	25,95	9,65	36,25	91	43,420	A-7-6	CH
15	2,428	23,273	56,70	28,31	6,35	28,39	90	41,711	A-7-6	CH
20	2,409	21,188	53,35	31,66	4,49	21,89	89	38,505	A-7-5	CH

Figure V.7 .Charts the percentage of escaped sieve number 200

3.3 Mechanical Test

1. Standard Proctor

The results of standard proctor test on native soil and mixed soil can be seen in Table V.7.

Table V.7. Standard Proctor test results on the mixture soil through sieve No. 4

Sample	Variasion	wopt (%)	γd maks (gr/cm^3)
1	Native soil	27,5	1,265
2	Native soil + wood charcoal powder 10 %	34,58	1,257
3	Native soil + wood charcoal powder 15 %	35,70	1,190
4	Native soil + wood charcoal powder 20 %	38,00	1,182

2. Consolidation Test

1. Consolidation Coefficient (Cv)

Table V.8 .The value of Cv between native soil for a mixture of wood charcoal powder with the percentage 10 % , 15 % and 20 %

Percentage Wood charcoal powder	value Cv maximum Cv90
Native soil	0,00022
10%	0,00024
15%	0,00059
20%	0,00077

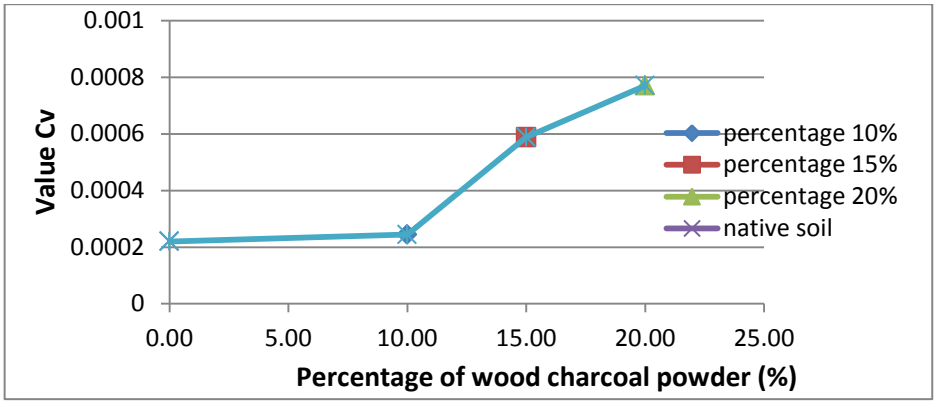

Figure V.11 .Charts the Cv with the mix 10 % , 15 % and 20 % in extract maximum value

from Figure V.11. Seen that every increase stabilization material with wood charcoal powder value Cv increased .This is because water contained in the soil absorbed by stabilization material and soil mixed with wood charcoal powder become more dry and improved mechanical characteristic .This can be read that process of consolidating need a relatively short time.

2. Compresion Index (Cc)

Table V.10. Value index compresion (Cc) that a mixture of wood charcoal powder with percentage 10 %, 15 % and 20 %

Percentage Wood charcoal powder (%)	Value (Cc)
Native soil	1,072
10%	0,954
15%	0,934
20%	0,702

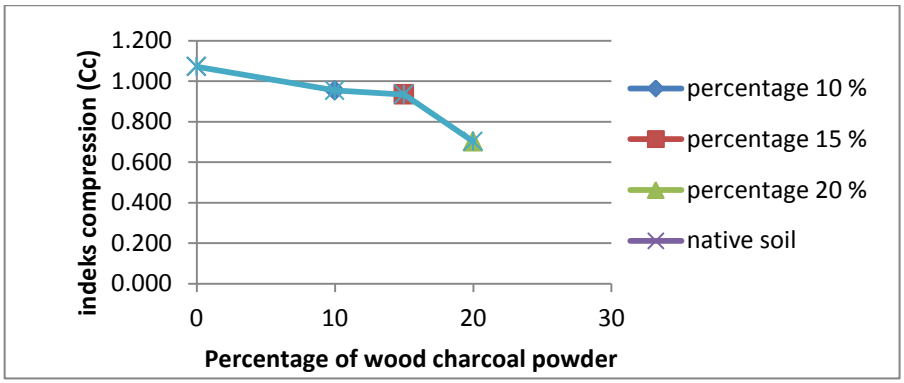

Figure V.12 .Charts the Cc with the percentage of wood charcoal powder 10 % , 15 % and 20 %

From Figure V.12 . Showing that the (Cc) was decreasing as you get the percentage of stabilization .This caused by process of consolidating faster that the process compresion of soil into small so that the (Cc) also narrowed.

3. Consolidation Settlement (Sc)

Table V.11. Value consolidated (Sc) that a mixture of wood charcoal powder with percentage 10 %, 15 % and 20 %

Percentage Wood charcoal powder (%)	value Sc
Native soil	0,393
10%	0,377
15%	0,282
20%	0,224

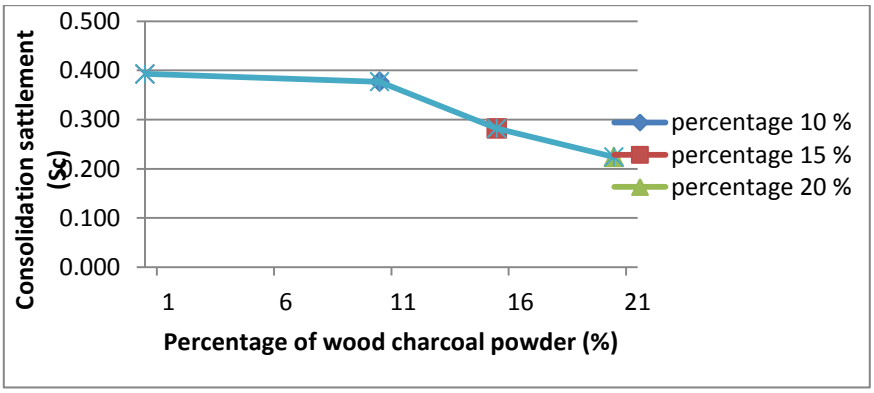

Figure V.13 .Charts the Sc with the percentage of wood charcoal powder 10 % , 15 % and 20 %

From Figure V.13 shows that bigger a mixture of powdered wood charcoal the decrease consolidated (Sc) getting smaller.This because of carelessness the more the percentage of added powdered charcoal tree so will be more dry soil so that the process of consolidated of the wane.

4. CONCLUSION AND RECOMENDATIONS

4.1 Conclusion

Based on research in a laboratory and data analysis experiment it can be taken conclusion as follows:

1. After testing shows mechanical of the nature of the soil of the value of PI was obtained from the native soil of 64,46 % , LL 91,50 % , PL 27,04 % , and value of SL 11,30 % this indicates that the soil from Sukodono as clay soil with high plasticity. On methode AASHTO the native soil of it includes on A-7-6 which means clay soil is bad and not better used as layers pavement is the foundation of road and building. While classifications USCS the ground according to the native soil of included in CH groups which means clay soil with high plasticity. On the ground a mixture of wood charcoal powder the value of the liquid limit , Shrinkage limit , plastis index , and the specific gravity of has experienced a fall in as you get the percentage, while the value of the water level and bounds plastis showing an upward trend.
2. Result of physical soil test the mixing wood charcoal powder with percentage 10%, 15% and 20% yields for Gs 2, 468 in mixture 10 %, 2,428 in mixture 15 % and 2,409 in mixture 20 %. Value of test atterberg limit at percentage 10% is liquid limit (LL)=62,20% ,plastic limit (PL)= 25,95%, plastisity index (PI)= 36,25% , and shrinkage limit (SL)= 9,65%, at percentage 15% is liquid limit (LL)=56,70%,plastic limit (PL)= 28,31%, plastisity index (PI) = 28,39% , and shrinkage limit (SL) = 6,35%, at percentage 20% is liquid limit (LL) = 53,55% ,plastic limit (PL) = 31,66%, plastisity index (PI) = 21,89% , and shrinkage limit (SL) = 4,49%. In the result value of plastisity index (PI) in AASHTO entering groups A-7-6 and USCS entering the group CH.
3. Compaction test results show that the greater percentage of wood charcoal powder hence the maximum dry volume weight increase and the optimum water content increase . In the consolidation test the value of the consolidation coefficient (Cv) increased as the addition of stabilization

materials. At compression index value (Cc) as addition of stabilization material the value of Cc decreases. And for the value of settlement consolidation (Sc) decreased with addition of stabilization materials. Based on the value of the consolidation coefficient (Cv), compression index (Cc), settlement consolidation (Sc) it can be concluded that from this research the soil improves the mechanical characteristic.

4.2 Recomendations

Based research conducted then for subsequent research suggested:

1. There needs to be testing with the another combination.
2. Make sure the ground in dry conditions that data air or better and right.
3. The stabilization can be replaced with another , besides wood charcoal powder that had been used.
4. There should be treatment before testing of consolidation sample because sample need chemical processes.

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